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INFORMATIONAL PAGE

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Title: Water Quality Assessment for the Development of Total Maximum Daily Loads for Dissolved Oxygen and Ammonia-Nitrogen in Mud Creek, Steuben County.

Sample Matrix: Water (X); Sediment (); Fish Tissue ()

Location: Lake Michigan Basin

Hydrologic Unit Code: 04050001

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Abstract or Summary:

The purpose of this study was to assess the impairments of Mud Creek for dissolved oxygen and ammonia-nitrogen as stated on the 303(d) List of Impaired Waterbodies. Three sampling events were completed in the summer through fall of 2000 to assess the dissolved oxygen and ammonia-nitrogen impairments. Mud Creek was assessed using the GLI Water Quality Standards for dissolved oxygen and ammonia-nitrogen. In the first sampling event, site LMJ110-0016 had dissolved oxygen of 3.70 mg/L and site LMJ110-0018 had dissolved oxygen of 3.79 mg/L. Both of these sites in the first sampling event violated the minimum dissolved oxygen water quality standard of 4.0 mg/L. The remaining sites in the first sampling event and all sites in the other two sampling events showed no dissolved oxygen water quality standard violation. There was no ammonia-nitrogen water quality standard violation found in any of the sampling events. It is recommended that further sampling be conducted at a later date, in June and July to see if the dissolved oxygen impairment still exists at the two sites on Mud Creek. It is also recommended that an effluent sample be collected from the Angola STP to see if it is contributing to the impairment. Since no ammonia-nitrogen violations occurred in the three sampling events, it is recommended that the ammonia-nitrogen impairment for Mud Creek be removed from the 303(d) List of Impaired Waterbodies.

Keywords: TMDL, Mud Creek, dissolved oxygen, ammonia-nitrogen



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Water Quality Assessment for the Development of Total Maximum Daily Loads for Dissolved Oxygen and Ammonia- Nitrogen in Mud Creek, Steuben County

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**Figure 1: Dissolved Oxygen and Ammonia-Nitrogen Violation Status Map
For Mud Creek**

Attachments (contact office for copies of Attachments)

A. Sampling and Analysis Work Plan for Mud Creek

B. Previous Data for Mud Creek

- i. 1994-1995 305 (b) Report**
- ii. 1998 Indiana Water Quality Report**

C. QA/QC Reports

- i. QA/QC Review Report: IDEM/100/29/477/023/2000**
- ii. QA/QC Review Report: IDEM/100/29/477/106/2000**
- iii. QA/QC Review Report: IDEM/100/29/477/115/2000**

Introduction

Mud Creek has its origin at the outfall of the Angola STP. Mud creek then flows south about three miles and joins Pigeon Creek. There are numerous lakes on Pigeon Creek, and one lake (Mud Lake) on Mud Creek. At its confluence with Pigeon Creek, Mud Creek has a drainage area of 5.31 square miles (Source: "Drainage Areas of Indiana Streams" by Richard E. Hoggatt, USGS & DNR, 1975).

IDEM Segment Survey sampling in June 1991 indicated dissolved oxygen level and total ammonia-N concentrations were not within acceptable levels in Mud Creek. The June 1991 segment survey sampled the Angola STP outfall and two sites on Mud Creek. Effluent and in stream total ammonia-N concentrations exceeded 7 mg/l. Mean and minimum dissolved oxygen concentrations were also violated.

Methods

A. Sampling Sites and Locations

Four sites for Mud Creek were sampled. Two sites were chosen on Mud Creek (LMJ110-0018, LMJ110-0019.) One site, LMJ110-0016, was chosen on Mud Creek Tributary. This site was chosen to obtain a sample from the Angola STP discharge. Site LMJ110-0024 was chosen to represent where Mud Creek flows into Pigeon Creek. These sampling sites were chosen to represent possible sources that could be contributing to the dissolved oxygen and ammonia-nitrogen impairments of Mud Creek. See Figure 1.

B. Sample Collection

A presurvey was first completed on July 5, 2000 to determine if the sites proposed could be sampled. A presurvey revealed that all of the proposed sites could be sampled. The three sampling events took place on July 5, 2000, September 12, 2000, and November 1, 2000. All four sites were sampled as two-part composites over a twenty-four hour period. Water samples were collected at the sites during each event in late afternoon, 2:00 p.m. – 5:00 p.m. and early morning, 2:00 a.m. – 5:00 a.m. The water samples were collected using a stainless steel bucket dropped over a bridge from the road or by wading into the stream and collecting the water sample using a fill bottle. The water was then transferred to the 1000 mL plastic round neck sample bottles. All ammonia-nitrogen samples were preserved with Sulfuric Acid. Ammonia-nitrogen samples were sent to Indiana State Department of Health Lab for analysis. The dissolved oxygen was measured in the field using a YSI™. For modeling purposes, general chemistry, nutrients, and flow measurements were obtained. For the last two sampling events, general chemistry and nutrient samples were collected in two-part composites in 1000 mL plastic round neck bottles and sent to Indiana State Department of Health Lab for analysis. Nutrients were preserved with Sulfuric Acid. Flow was measured on the third sampling event.

C. Field Measurements

Field parameters were measured at each site during each sampling event using the YSI™, multiparameter data sonde, as stated in the Work Plan (See Attachment A.) These parameters included pH, water temperature, specific conductivity, turbidity, percent saturation, chloride, chlorophyll. Field calibration was completed for dissolved oxygen, using a Winkler Test, and pH, using a Hach pH meter. Weather conditions, wind strength, air temperature, and cloud conditions were also noted at each site for each sampling event.

D. Protocol Deviations

Two deviations occurred to the original Work Plan. The first deviation was due to scheduling constraints. The last sampling run took place on November 1, 2000 versus October 31, 2000 as stated in the Work Plan.

The second deviation has to do with general chemistry and nutrients measurements that were sampled for twice. In order to get an accurate flow measurement for modeling purposes, flow must be measured on the same sampling event that general chemistry and nutrients are taken. Since flow was not measured during the second sampling event, general chemistry and nutrients had to be collected again along with flow measurements on the third sampling event.

Results

A. Dissolved Oxygen

The diurnal dissolved oxygen concentrations collected as a two-part composite over a 24 hour time period shall average at least 5.0 mg/L per calendar day and shall not be less than 4.0 mg/L at any time (327 IAC 2-1-6.) In the first sampling event, site LMJ110-0016 had a dissolved oxygen value of 3.70 mg/L and site LMJ110-0018 had a dissolved oxygen value of 3.79 mg/L. Both of these sites violated the minimum dissolved oxygen value of 4.0 mg/L at any time. The remaining sites in the first sampling event and all sites in the other two sampling events showed no dissolved oxygen water quality standard violation. See Table 1 for dissolved oxygen data results.

B. Ammonia-Nitrogen

The ammonia-nitrogen water quality standard is based on a relationship between temperature and pH (327 IAC 2-1.5-8.) Since the IDEM staff collected temperature and pH data as a two-part composite over a 24-hour period, the temperature and pH were averaged to create a mean temperature and a mean pH for each sampling site. The two-part composite water sample was analyzed for ammonia-nitrogen in the lab as one sample. The sample data collected at each site was then compared to the calculated

ammonia-nitrogen value for the particular temperature and pH. All ammonia-nitrogen values met ammonia-nitrogen water quality standards. See Table 2 for ammonia-nitrogen data results.

C. General Chemistry and Nutrients

All general chemistry and nutrient results were compared with numeric water quality standards (327 IAC 2-1-6) or with background concentrations collected by other IDEM staff in that area. All general chemistry and nutrient data collected for the parameters were valid except for Alkalinity. The lab recorded a contamination of the field blank for alkalinity in the third sampling event. An alkalinity of 2 mg/L was detected in the field blank, therefore all alkalinity data, for the third sampling event, above 10 mg/L is acceptable. See Table 3 for general chemistry and nutrient data results.

D. Field Data

All field data was collected using a YSI™. The YSI™ was calibrated by IDEM staff before going on each sampling event and was field checked according to the workplan. All field data is valid except that the chlorophyll data collected on the first sampling. The chlorophyll probe on the YSI was not calibrated before the sampling event. See Table 4 for field data results.

E. Field Observations

On the first sampling event, site LMJ110-0016 had no tree cover on the side the sample was taken and 80%-100% tree cover on the other side on the road. During the morning on the first sampling event, LMJ110-0024 was sampled in light rain. Site LMJ110-0019 was sampled from a stagnant pool. The second sampling event took place after a recent rain. During this sampling event, lots of sediment runoff was observed at site LMJ110-0016.

Discussion

Two sites, LMJ110-0016 and LMJ110-0018, had dissolved oxygen violations in the first sampling event. However, in the other two sampling events the dissolved oxygen was not in violation. The general chemistry and nutrient results for the second sampling event showed a high T.O.C, and was found even higher in the third sampling event.

The general chemistry and nutrient results show a dramatic increase in the values for all parameters from sites LMJ110-0016 to LMJ110-0019. Once Mud Creek flows into Pigeon Creek the values lower dramatically. It appears that the dissolved oxygen violations and the causes of the increased general chemistry and nutrient values in Mud Creek could be coming from some point after Mud Creek Tributary enters Mud Creek.

Recommendations

- An effluent sample or a site closer to the point of effluent discharge into Mud Creek be collected in future sampling. This will help to determine if the dissolved oxygen violation is occurring before Mud Creek Tributary enters Mud Creek.
- Additional sampling be completed at a later date during June and/or July to see if the dissolved oxygen violation occurs again. Also it is recommended that general chemistry and nutrients be taken again to provide more information to explain what is happening in the stream at the sampling time.
- The summer of 2000 sampling indicated that no ammonia-nitrogen violation occurred. It is recommended the ammonia-nitrogen parameter be removed from Mud Creek from the 303(d) List of Impaired Waterbodies.

Table 1: Diurnal Dissolved Oxygen Values for Mud Creek
(Afternoon: 2:00 pm – 5:00 pm, Morning: 2:00 am – 5:00 am)

First Sampling Event:

Site ID #	Stream Name	Site Info	Start Date	End Date	IDEM #	DO (mg/L)			DO WQS (mg/L)		WQS Violation?	
						Afternoon	Morning	Mean	Minimum	Mean	Minimum	Mean
LMJ110-0016	Mud Creek Tributary	Bill Dellar Rd. near STP outfall	7/5/00	7/6/00	AA00635	10.06	3.70	6.88	4.00	5.00	YES	NO
LMJ110-0018	Mud Creek	Bill Dellar Rd	7/5/00	7/6/00	AA00637	9.65	3.79	6.72	4.00	5.00	YES	NO
LMJ110-0019	Mud Creek	CR 275 S	7/5/00	7/6/00	AA00639	8.36	6.07	7.22	4.00	5.00	NO	NO
LMJ110-0024	Pigeon Creek	Meridian Road	7/5/00	7/6/00	AA00640	7.53	7.58	7.56	4.00	5.00	NO	NO

Second Sampling Event:

Site ID #	Stream Name	Site Info	Start Date	End Date	IDEM #	DO (mg/L)			DO WQS (mg/L)		WQS Violation?	
						Afternoon	Morning	Mean	Minimum	Mean	Minimum	Mean
LMJ110-0016	Mud Creek Tributary	Bill Dellar Rd. near STP outfall	9/12/00	9/13/00	AA01591	7.81	6.10	6.96	4.00	5.00	NO	NO
LMJ110-0018	Mud Creek	Bill Dellar Rd	9/12/00	9/13/00	AA01593	7.54	5.80	6.67	4.00	5.00	NO	NO
LMJ110-0019	Mud Creek	CR 275 S	9/12/00	9/13/00	AA01594	6.96	6.90	6.93	4.00	5.00	NO	NO
LMJ110-0024	Pigeon Creek	Meridian Road	9/12/00	9/13/00	AA01595	6.85	6.83	6.84	4.00	5.00	NO	NO

Third Sampling Event:

Site ID #	Stream Name	Site Info	Start Date	End Date	IDEM #	DO (mg/L)			DO WQS (mg/L)		WQS Violation?	
						Afternoon	Morning	Mean	Minimum	Mean	Minimum	Mean
LMJ110-0016	Mud Creek Tributary	Bill Dellar Rd. near STP outfall	11/1/00	11/2/00	AA03036	9.48	7.42	8.45	4.00	5.00	NO	NO
LMJ110-0018	Mud Creek	Bill Dellar Rd	11/1/00	11/2/00	AA03038	10.30	6.66	8.48	4.00	5.00	NO	NO
LMJ110-0019	Mud Creek	CR 275 S	11/1/00	11/2/00	AA03039	15.10	7.22	11.16	4.00	5.00	NO	NO
LMJ110-0024	Pigeon Creek	Meridian Road	11/1/00	11/2/00	AA03040	10.48	8.87	9.68	4.00	5.00	NO	NO

Table 2: Ammonia-Nitrogen Values for Mud Creek

First Sampling Event:

<u>Site ID #</u>	<u>Stream Name</u>	<u>Site Info</u>	<u>Start Date</u>	<u>End Date</u>	<u>IDEM #</u>	<u>PM pH</u>	<u>AM pH</u>	<u>PM Temp (°C)</u>	<u>AM Temp (°C)</u>	<u>Mean pH</u>	<u>Mean Temp (°C)</u>	<u>**Sample NH3-N (mg/L)</u>	<u>NH3-N CCC</u>	<u>WQS Violation?</u>
LMJ110-0016	Mud Creek Tributary	Bill Dellar Rd. near STP outfall	7/5/00	7/6/00	AA00635	8.00	7.44	30.71	22.28	7.7	26	0.10	2.053	NO
LMJ110-0018	Mud Creek	Bill Dellar Rd	7/5/00	7/6/00	AA00637	7.78	7.54	30.64	24.87	7.7	28	0.50	2.060	NO
LMJ110-0019	Mud Creek	CR 275 S	7/5/00	7/6/00	AA00639	7.69	7.60	30.29	26.16	7.6	28	0.40	2.073	NO
LMJ110-0024	Pigeon Creek	Meridian Road	7/5/00	7/6/00	AA00640	7.85	7.86	31.54	25.35	7.9	28	0.10	1.512	NO

Second Sampling Event:

<u>Site ID #</u>	<u>Stream Name</u>	<u>Site Info</u>	<u>Start Date</u>	<u>End Date</u>	<u>IDEM #</u>	<u>PM pH</u>	<u>AM pH</u>	<u>PM Temp (°C)</u>	<u>AM Temp (°C)</u>	<u>Mean pH</u>	<u>Mean Temp (°C)</u>	<u>**Sample NH3-N (mg/L)</u>	<u>NH3-N CCC</u>	<u>WQS Violation?</u>
LMJ110-0016	Mud Creek Tributary	Bill Dellar Rd. near STP outfall	9/12/00	9/13/00	AA01591	8.07	7.65	22.77	18.34	7.9	21	0.10	1.500	NO
LMJ110-0018	Mud Creek	Bill Dellar Rd	9/12/00	9/13/00	AA01593	7.60	7.48	21.38	16.94	7.5	19	0.20	2.083	NO
LMJ110-0019	Mud Creek	CR 275 S	9/12/00	9/13/00	AA01594	7.44	7.41	20.66	16.75	7.4	19	0.10	2.078	NO
LMJ110-0024	Pigeon Creek	Meridian Road	9/12/00	9/13/00	AA01595	7.66	7.72	20.40	17.86	7.7	19	0.10	2.069	NO

Third Sampling Event:

<u>Site ID #</u>	<u>Stream Name</u>	<u>Site Info</u>	<u>Start Date</u>	<u>End Date</u>	<u>IDEM #</u>	<u>PM pH</u>	<u>AM pH</u>	<u>PM Temp (°C)</u>	<u>AM Temp (°C)</u>	<u>Mean pH</u>	<u>Mean Temp (°C)</u>	<u>**Sample NH3-N (mg/L)</u>	<u>NH3-N CCC</u>	<u>WQS Violation?</u>
LMJ110-0016	Mud Creek Tributary	Bill Dellar Rd. near STP outfall	11/1/00	11/2/00	AA03036	7.53	7.38	12.57	8.34	7.5	10	0.20	2.202	NO
LMJ110-0018	Mud Creek	Bill Dellar Rd	11/1/00	11/2/00	AA03038	7.90	7.67	16.38	12.46	7.8	14	0.20	1.812	NO
LMJ110-0019	Mud Creek	CR 275 S	11/1/00	11/2/00	AA03039	8.18	7.66	13.71	11.87	7.9	13	0.10	1.544	NO
LMJ110-0024	Pigeon Creek	Meridian Road	11/1/00	11/2/00	AA03040	7.93	7.85	11.86	10.73	7.9	11	0.10	1.566	NO

** Collected as a two-part composite sample, but were analyzed as one sample in the lab.

Table 3: General Chemistry and Nutrients Data for Mud Creek**Second Sampling Event:**

<u>Parameters</u>	<u>Site</u>			
	<u>LMJ110-0016</u>	<u>LMJ110-0018</u>	<u>LMJ110-0019</u>	<u>LMJ110-0024</u>
<u>C-BOD LR (mg/L)</u>	6.9	8.1	6.4	8
<u>TKN (mg/L)</u>	0.7	1.6	1.4	1.8
<u>Nitrate+Nitrite (mg/L)</u>	0.2	6.2	5.7	2.7
<u>Total Phosphorus (mg/L)</u>	0.04	0.33	0.26	0.16
<u>TOC (mg/L)</u>	7.6	11.2	11.8	12.4
<u>COD (mg/L)</u>	26.1	40	45.1	44
<u>Alkalinity (mg/L)</u>	129	211	223	221
<u>Total Solids (mg/L)</u>	263	820	774	540
<u>Suspended Solids (mg/L)</u>	14	63	51	42
<u>Dissolved Solids (mg/L)</u>	243	726	694	493
<u>Sulfate (mg/L)</u>	28	64	73	82
<u>Chloride (mg/L)</u>	29	205	170	45
<u>Hardness (mg/L)</u>	169	352	360	369

Third Sampling Event

<u>Parameters</u>	<u>Site</u>			
	<u>LMJ110-0016</u>	<u>LMJ110-0018</u>	<u>LMJ110-0019</u>	<u>LMJ110-0024</u>
<u>TKN (mg/L)</u>	0.8	1.6	1.5	1.0
<u>Nitrate+Nitrite (mg/L)</u>	0.2	14.0	11.0	2.6
<u>Total Phosphorus (mg/L)</u>	0.03	0.44	0.36	0.07
<u>COD (mg/L)</u>	19.6	23.9	25.5	26.7
<u>*Alkalinity (mg/L)</u>	231	296	309	283
<u>Total Solids (mg/L)</u>	451	1601	1480	685
<u>Suspended Solids (mg/L)</u>	17	19	7	10
<u>Dissolved Solids (mg/L)</u>	423	1576	1447	652
<u>Sulfate (mg/L)</u>	79	190	200	100
<u>Chloride (mg/L)</u>	29	635	555	110
<u>Hardness (mg/L)</u>	328	422	432	410
<u>C-B.O.D. (5 days) (mg/L)</u>	1.0	1.1	1.0	1.4

* Blank had a 2.0 mg/L, therefore anything above 10.0 mg/L is accepted.

Table 4: Standard Field Data for Mud Creek

**First Sampling
Event**

Site ID #	Stream Name	Description	Sample Number	SpecialNotes	Sample Date	SampleTime	Dissolved Oxygen (mg/L)	pH	Water Temp (mg/L)	Specific Conductivity (uS/cm)	Turbidity (NTU)	Chlorine (mg/L)	Chloride (mg/L)	Chlorophyll (mg/L)	Saturation %	Comments
LMJ110-0016	Mud Creek Tributary	Bill Dellar Rd. near STP outfall	AA00635		7/6/00	3:51:00 AM	3.7	7.44	22.28	619	8.7			3.1		CHLOROPHYLL NOT CALIBRATED -- MILD RAIN
LMJ110-0016	Mud Creek Tributary	Bill Dellar Rd. near STP outfall	AA00635		7/5/00	3:30:00 PM	10.06	8	30.71	588	19			0.5		BRIGHT SUN -- SAMPLE MAY HAVE WARMED IN BUCKET -- CHLOROPHYLL NOT CALIBRATED
LMJ110-0018	Mud Creek	Bill Dellar Rd.	AA00637	80-100% canopy cover on D/S side of Road	7/6/00	3:36:00 AM	3.79	7.54	21.61	1515	13.4			0.7		CHLOROPHYLL NOT CALIBRATED
LMJ110-0018	Mud Creek	Bill Dellar Rd.	AA00637	80-100% canopy cover on D/S side of Road	7/5/00	3:25:00 PM	9.65	7.78	22.83	1346	9.7			4.1		CHLOROPHYLL NOT CALIBRATED
LMJ110-0019	Mud Creek	275 South Rd.	AA00639		7/6/00	3:24:00 AM	6.07	7.6	21.3	1356	13.4			1.6		CHLOROPHYLL NOT CALIBRATED
LMJ110-0019	Mud Creek	275 South Rd.	AA00639		7/5/00	3:05:00 PM	8.36	7.69	22.64	1219	8.3			2.7		CHLOROPHYLL NOT CALIBRATED
LMJ110-0024	Pigeon Creek	Meridian Road	AA00640		7/6/00	3:07:00 AM	7.58	7.86	22.1	682	19.5			24.2		CHLOROPHYLL NOT CALIBRATED -- drizzle
LMJ110-0024	Pigeon Creek	Meridian Road	AA00640		7/5/00	2:45:00 PM	7.53	7.85	23.24	658	18.4			18.3		CHLOROPHYLL NOT CALIBRATED

Table 4 (continued)

Second Sampling Event																
<u>Site ID #</u>	<u>Stream Name</u>	<u>Description</u>	<u>Sample Number</u>	<u>SpecialNotes</u>	<u>Sample Date</u>	<u>Sample Time</u>	<u>Dissolved Oxygen (mg/L)</u>	<u>pH</u>	<u>Water Temp (mg/L)</u>	<u>Specific Conductivity (uS/cm)</u>	<u>Turbidity (NTU)</u>	<u>Chlorine (mg/L)</u>	<u>Chloride (mg/L)</u>	<u>Chlorophyll (mg/L)</u>	<u>Saturation %</u>	<u>Comments</u>
LMJ110-0016	Mud Creek Tributary	Bill Dellar Rd. near STP outfall	AA01591	Sample for Ammonia and CBODu recent rain event	9/13/00	2:45:00 AM	6.1	7.65	18.34	422	11		37.23	10.1	64.3	clear
LMJ110-0016	Mud Creek Tributary	Bill Dellar Rd. near STP outfall	AA01591	Sample for Ammonia and CBODu recent rain event	9/12/00	2:40:00 PM	7.81	8.07	22.77	411	7.6		39.74	14.9	91.3	
LMJ110-0018	Mud Creek	Bill Dellar Rd.	AA01593	Lots of sediment runoff	9/13/00	3:05:00 AM	5.8	7.48	16.94	708	42.3		234	13	59.8	
LMJ110-0018	Mud Creek	Bill Dellar Rd.	AA01593	Lots of sediment runoff	9/12/00	3:00:00 PM	7.54	7.6	21.38	1087	84.1		197.6	15.7	85.6	
LMJ110-0019	Mud Creek	275 South Rd.	AA01594	Deep pool. Culvert 2' below waterline.	9/13/00	3:37:00 AM	6.9	7.41	16.75	1288	14.3		221	13.9	70.7	water has musty odor
LMJ110-0019	Mud Creek	275 South Rd.	AA01594	Deep pool. Culvert 2' below waterline.	9/12/00	3:15:00 PM	6.96	7.44	20.66	1050	48.6		185.1	14.9	77.8	
LMJ110-0024	Pigeon Creek	Meridian Road	AA01595		9/13/00	3:47:00 AM	6.83	7.72	17.86	767	24.6		60.29	13.8	71.9	
LMJ110-0024	Pigeon Creek	Meridian Road	AA01595		9/2/00	3:25:00 PM	6.85	7.66	20.4	732	42.5		67.09	15.7	76.1	

Table 4 (continued)

**Third Sampling
Event**

<u>Site ID #</u>	<u>Stream Name</u>	<u>Description</u>	<u>Sample Number</u>	<u>SpecialNotes</u>	<u>Sample Date</u>	<u>SampleTime</u>	<u>Dissolved Oxygen (mg/L)</u>	<u>pH</u>	<u>Water Temp (mg/L)</u>	<u>Specific Conductivity (uS/cm)</u>	<u>Turbidity (NTU)</u>	<u>Chlorine (mg/L)</u>	<u>Chloride (mg/L)</u>	<u>Chlorophyll (mg/L)</u>	<u>Saturation %</u>	<u>Comments</u>
LMJ110-0016	Mud Creek Tributary	Bill Dellar Rd. near STP outfall	AA03036		11/2/00	2:22:00 AM	7.42	7.38	8.34	1379	13.8		314.5	7.9	63.2	
LMJ110-0016	Mud Creek Tributary	Bill Dellar Rd. near STP outfall	AA03036		11/1/00	2:24:00 PM	9.48	7.53	12.57	1379	48.5		312	11.4	89.5	
LMJ110-0018	Mud Creek	Bill Dellar Rd.	AA03038		11/2/00	2:34:00 AM	6.66	7.67	12.46	6049	25.7		610	6.2	63.1	
LMJ110-0018	Mud Creek	Bill Dellar Rd.	AA03038		11/1/00	2:43:00 PM	10.3	7.9	16.38	5308	26.7		555	8.3	106.9	
LMJ110-0019	Mud Creek	275 South Rd.	AA03039		11/2/00	2:49:00 AM	7.22	7.66	11.87	5705	9.9		645	7.4	66.6	
LMJ110-0019	Mud Creek	275 South Rd.	AA03039		11/1/00	2:58:00 PM	15.1	8.18	13.71	4634	4.1		570	14.4	147.9	
LMJ110-0024	Pigeon Creek	Meridian Road	AA03040		11/2/00	3:02:00 AM	8.87	7.85	10.73	2174	7.6		428.5	9.4	79.9	
LMJ110-0024	Pigeon Creek	Meridian Road	AA03040		11/1/00	3:06:00 PM	10.48	7.93	11.86	2127	6.6		451	10	97.7	

Figure 1: Dissolved Oxygen and Ammonia-Nitrogen Violation Status Map for Mud Creek

